Report for 2005TX194B: Determining the Efficacy of Biological Control of Saltcedar (Tamarix spp.) on the Colorado River of Texas

Publications

- There are no reported publications resulting from this project.

Report Follows

Determining the Efficacy of Biological Control of Saltcedar (Tamarix spp.)

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Saltcedar are deciduous trees indigenous to arid, riparian habitats of Eurasia. Several species of saltcedar (*Tamarix* spp., Family Tamaricaceae) were introduced into North America during the 19th and 20th centuries. Upon their importation into the US, these trees were released from the pressures of most of the natural enemies found in their native range. Partly as a consequence of their natural enemy release, saltcedar has become highly invasive in arid ecosystems of the western United States. An estimated 2 million acres of riparian ecosystems in the US, including 500,000 acres in Texas alone, are infested with saltcedar. Saltcedar displaces native vegetation, reduces stream flows, increases soil and water salinity, and consumes significant quantities of groundwater. Saltcedar is widely distributed along most of the watersheds of western Texas including the Brazos, Colorado, Pecos and Rio Grande Rivers. Many of these river basins are beginning to suffer from severe water shortages. More than 21,000 acres of the Colorado River are infested with saltcedar. The Colorado River Municipal Water District estimates that existing stands of saltcedar in the Upper Colorado River basin may be consuming more than 90,000 acre-feet of water annually.

The release of a biological control agent can be highly specific to saltcedar, relatively inexpensive, and may provide long term suppression in areas susceptible to re-infestation. After extensive host-specificity studies by USDA-ARS scientists, the saltcedar leaf beetle, *Diorhabda elongata* (Coleoptera: Chrysomelidae), has been approved for open field releases in Texas. The purpose of this study was to evaluate the efficacy of using the saltcedar leaf beetle as a biological control agent in Texas. We studied two release sites within the Colorado River watershed to determine beetle establishment and dispersal rates. In addition, we studied the impact of beetle defoliation on the tree starch reserves and the propensity of trees to regrow following defoliation.

Objectives

The objectives of this project were to:

(1) Monitor the open field establishment of *Diorhabda elongata* beetles and describe their dispersal from release sites along the Upper Colorado River.

(2) Characterize the impact of beetle feeding on saltcedar trees by measuring the changes in starch storage and amount of regrowth of the trees subjected to beetle herbivory.

Progress and Results

Beetle Establishment and Dispersal

Beetles were released at two locations within the Upper Colorado River basin in 2004. Trees along transects were surveyed monthly for beetle presence and degree of tree defoliation during the 2005 growing season (May-September). Beetles established at one

of two release sites. No beetles were detected at the Lake Thomas (Scurry Co.) site in 2005. Beetles did establish and disperse at the Beals Creek site (Howard Co.). By September 2005, beetles were detected on 29 of 45 trees surveyed, and on some trees, beetle numbers were high enough to result in tree defoliation (Figure1). Beetles were found on the furthest trees surveyed, 200meters from the point of release, and over 200 trees were completely defoliated by beetles by the end of the 2005 season (Image1).

Beetle Feeding

The saltcedar leaf beetle feeds exclusively on the leaves of the target trees which can result in large-scale tree defoliation. However, field observations to date have shown that defoliation does not immediately kill the trees. Biological control of saltcedar is expected to be a gradual process as trees become less competitive due to repeated defoliation by *D. elongata*. Field cage and natural experiments were used to test the hypothesis that defoliation due to beetle feeding decreases starch reserves and tree regrowth.

Field cage experiments conducted at Lake Thomas indicate that trees defoliated late in the growing season stored slightly less starch when compared to control trees, though this difference was not statistically significant (Figure2) due in part to the limits of experimental replication. However, the same defoliated trees in the experiment grew significantly less spring foliage when compared to control trees (Figure3).

In cooperation with colleagues at USDA-ARS laboratory in Reno, Nevada, a natural experiment was conducted at a site near Lovelock, Nevada. Beetles released by the Nevada Department of Agriculture successfully established at this site in 2001. Each year since the 2001 release, the beetles dispersed further from the release point defoliating more saltcedar trees in their wake. By 2005, over two thousand hectares of saltcedar had been defoliated. Core samples from the root crown were taken from trees that had been fully defoliated for three, two, one and zero seasons. Samples were analyzed for starch concentrations. The results clearly indicate that trees defoliated for at least one growing season have a significant reduction in starch reserves (Figure4). These data further support our hypothesis that beetle feeding results in decreases in starch reserves which in turn may lead to less tree growth.

Project Implications:

Biological control is only one tool in the arsenal being employed to combat the saltcedar invasion. An integrated management program is necessary for effective saltcedar control. For saltcedar control along the Colorado River and other river basins, large-scale herbicidal treatments have been initiated. While an effective control strategy, herbicide treatments are expensive and impractical in some situations. Biological control potentially offers an effective supplement to control methods based on herbicide treatments.

To effectively assist in the management of saltcedar, the saltcedar leaf beetle, *Diorhabda elongata*, must be able to establish and disperse in areas of introduction. Secondly, the beetle must make an appreciable impact on the target pest. Our studies show that *D.*

elongata is establishing and dispersing from release sites in the Upper Colorado River basin. Additionally, field cage and natural experiments indicate that beetle defoliation is reducing tree starch reserves and subsequent tree regrowth.

The results from this study are adding to our understanding of how *D. elongata* survives and impacts saltcedar and will help us make decisions regarding the integration of biological control into an area-wide program for saltcedar management in Texas.

Education:

This work was presented at several local and regional forums during the granting period:

TAMU Student Research Week (March 2005, College Station, Texas)
Aquatic Plant Management Society Meeting (July 2005, San Antonio, Texas)
Dept. of Entomology Graduate Student Forum (August 2005, College Station, Texas)
SW Branch of the Entomological Society of America (February 2006, Austin, Texas)
Saltcedar Biological Control Consortium (March 2006, Austin, Texas)

Additionally, this project and related work were featured in two Texas newspapers in July 2005: the Lubbock Avalanche Journal and the San Antonio Express. Parts of the San Antonio Express article were circulated in additional newspapers throughout the state. These articles can be found at the following link:
http://insects.tamu.edu/feature/saltcedar/

Beals Creek, September 2005

Figure 1

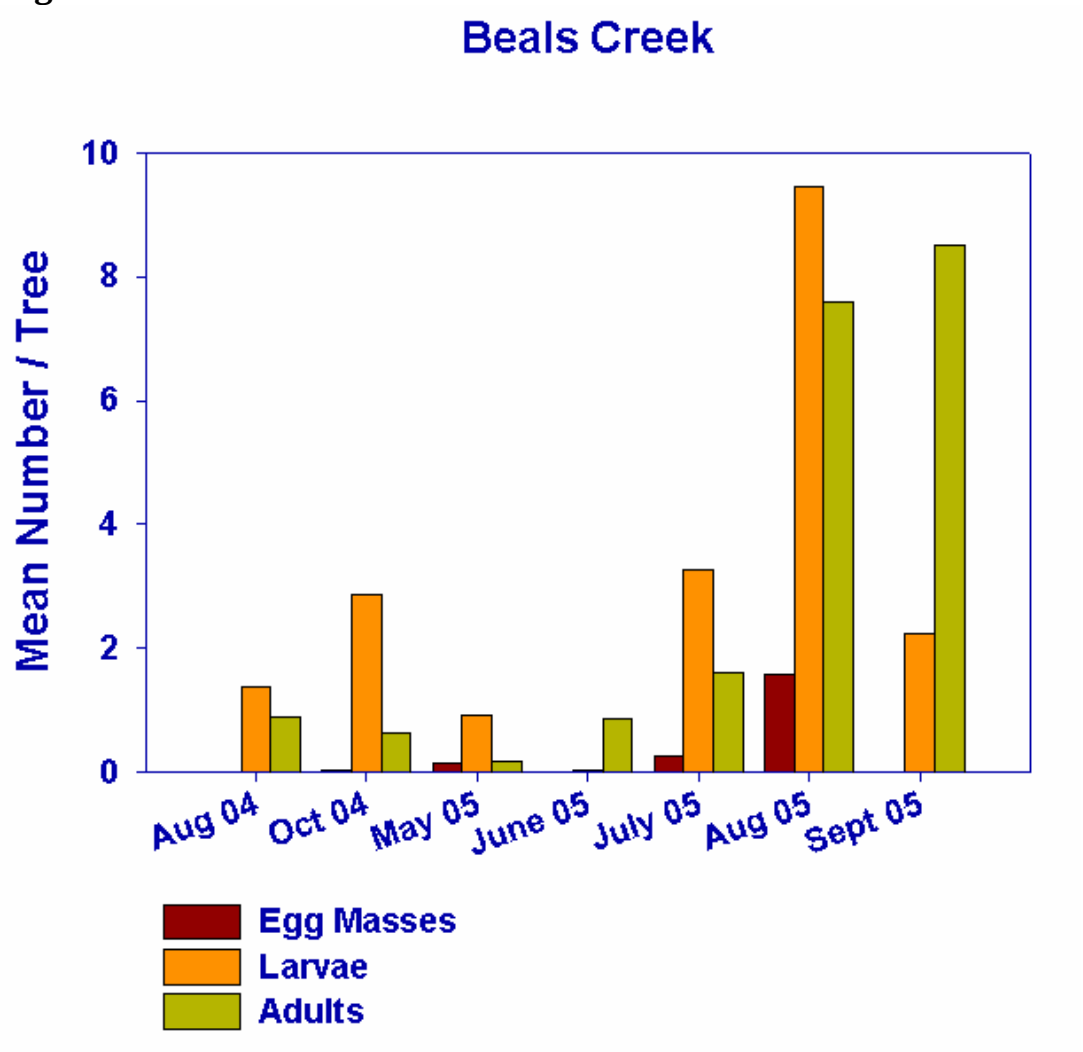

Beals Creek
Mean Number / Tree
10
8
6
4
2
0
Aug 04
Oct 04
May 05
June 05
July 05
Aug 05
Sept 05
Egg Masses
Larvae
Adults

Figure 2

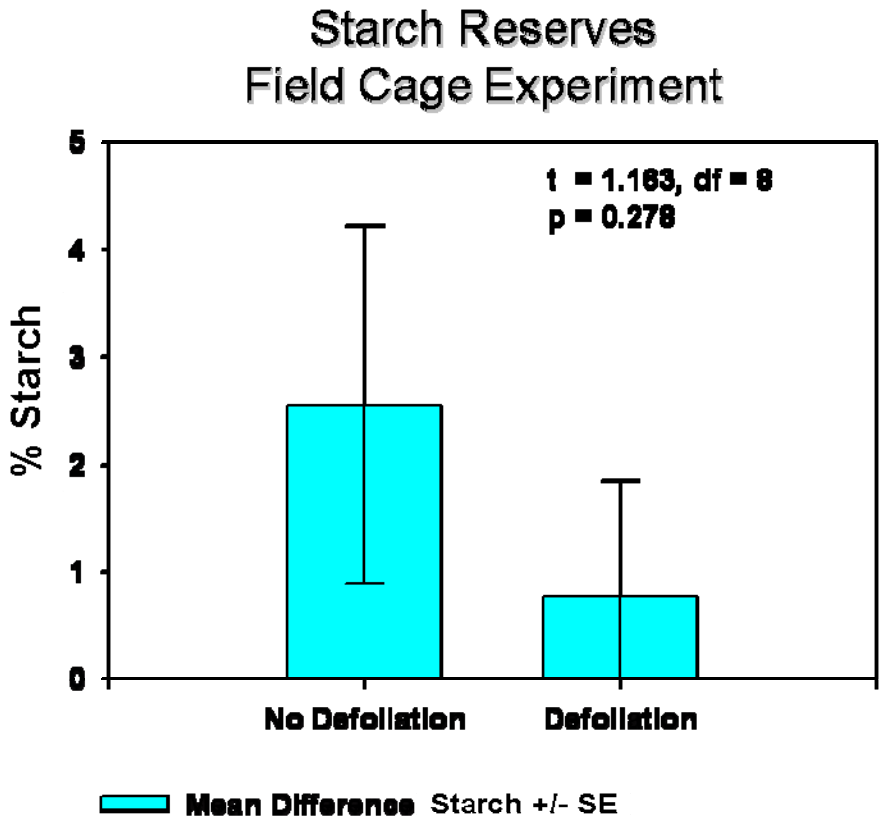

Starch Reserves
Field Cage Experiment
t = 1.163, df = 8
p = 0.278
% Starch
0
1
2
3
4
5
No Defoliation
Defoliation
Mean Difference Starch +/- SE

Figure 3

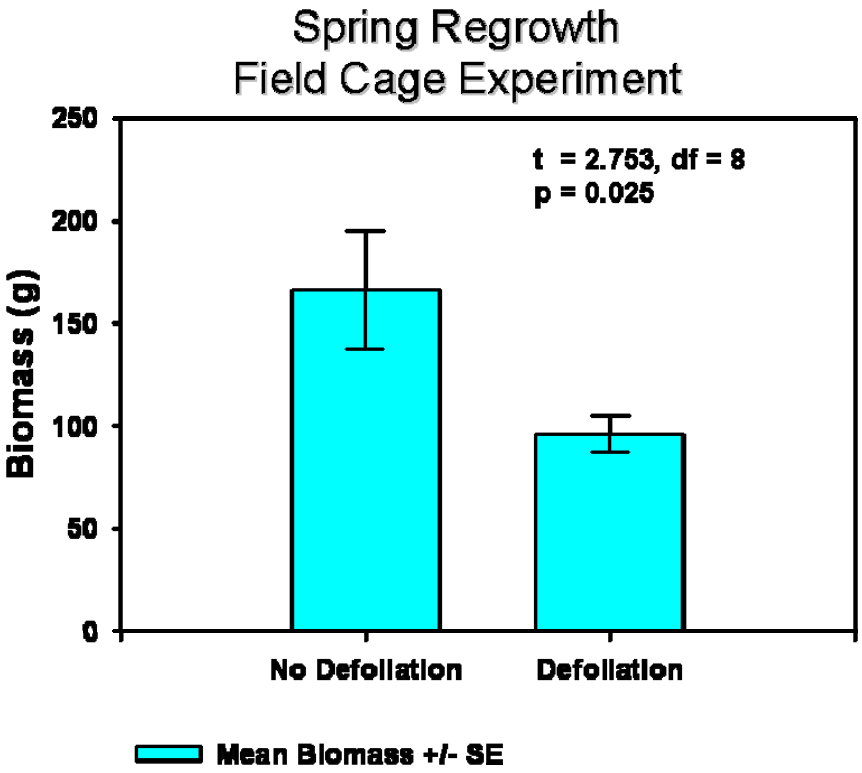
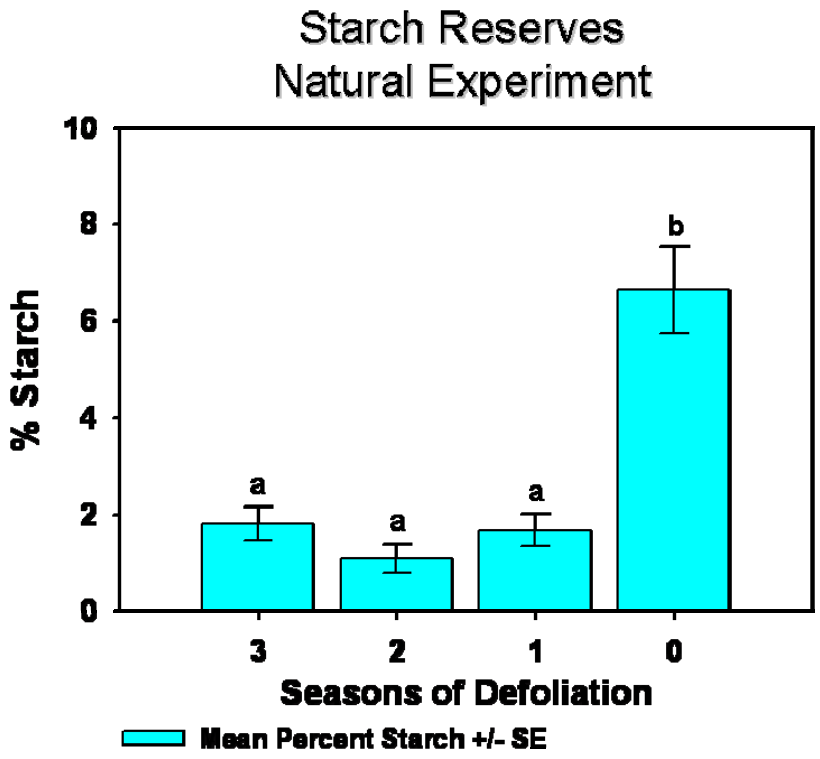

Spring Regrowth
Field Cage Experiment
t = 2.753, df = 8
p = 0.025
Biomass (g)
250
200
150
100
50
0
No Defoliation
Defoliation
Mean Biomass +/- SE

Figure 4


Starch Reserves
Natural Experiment
10
8
6
4
2
0
% Starch
a
a
a
b
3
2
1
0
Seasons of Defoliation
Mean Percent Starch +/- SE